

SC General Services Division **Safety Program and Policy Manual**

SUBJECT: LOCKOUT TAGOUT PROGRAM
(Control of Hazardous Energies & Safe Electrical Work Practices)
DATE: MARCH 1995
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Program

I. INTRODUCTION

Electricity and other energies are essential to modern life, at home and on the job. Some employees work with these energies directly, such as our Trades Specialists in the Facilities Management Section. Others, such as office administrative employees, work with it indirectly. Electricity has long been recognized as a serious workplace hazard, exposing employees to such dangers as electric shock, arc flash, burns, fires, and explosions. In 2001 for example, there were 7,600 electrical injuries and 432 work-related deaths with low-voltage electrocution as the fourth leading cause. Experts in electrical safety have traditionally looked toward the widely used National Fire Protection Association (NFPA) standards and the Occupational Safety and Health Administration (OSHA) standards for help in the practical safeguarding of persons from hazardous energies. However, besides electricity, there are other hazardous energy sources such as mechanical, pneumatic, fluids and gases, hydraulic, thermal, water under pressure, and gravity. Some of the problems of not properly controlling these hazardous energies include accidental start-ups resulting in disabling injuries and death. The OSHA-prescribed Lockout/Tagout (LOTO) procedure and safe work practices when used protect workers from the potentially dangerous effects of these hazardous energies.

II. PURPOSE

The purpose of this LOTO program is to prevent personnel injury by the unexpected energization, start-up, or release of a hazardous energy. The worker performing servicing or maintenance must be able to disable all power sources in such a way that only that worker can restore power. As required by the OSHA standard, the General Services Division establishes this program and procedures for affixing appropriate lockout and/or tagout apparatus to energy isolation devices so machinery or equipment is disabled thus preventing unexpected energization and start up of the machine or equipment, or release of stored energy.

III. OSHA REGULATORY REFERENCES

South Carolina incorporates by reference the federal regulations. Therefore, the state requirements are identical to the federal requirements. The South Carolina Budget and

Control Board, General Services Division, is governed by these federal and state requirements.

1. South Carolina Code of Regulations, Department of Labor, Licensing and Regulation, Division of Labor, Chapter 71, Article 1 Occupational Safety and Health Regulations
2. Title 29, Code of Federal Regulations (CFR), Chapter 1910.147, The Control of Hazardous Energy, Lockout Tagout (29 CFR 1910.147)
3. 29 CFR Subpart S - Electrical, 1910.331-335 Electrical Safety-Related Work Practices
4. 29 CFR Subpart K - Electrical General, 1926.400-449

NOTE: OSHA references *NFPA 70 - National Electrical Code* and *NFPA 70E - Electrical Safety Requirements for Employee Workplaces* as “how to guides” to comply with the above OSHA standards.

IV. POLICY

1. Employees designated by General Services to service and maintain various pieces of equipment and use machinery face the potential for unexpected activation and/or energy release. **IN THOSE CIRCUMSTANCES, WHERE THE MACHINE OR EQUIPMENT CAN BE DE-ENERGIZED TO PERFORM THE SERVICING OR MAINTENANCE, THE MACHINE OR EQUIPMENT MUST BE DE-ENERGIZED, LOCKED OUT AND TAGGED OUT IN ACCORDANCE WITH PROCEDURE ESTABLISHED BY THIS PROGRAM.** During servicing or maintenance, if an authorized employee is simultaneously exposed to a potential unexpected activation or release of energy from interconnected or nearby machinery or equipment, the energy control procedures and safe work practices for all hazardous energy sources on that machine or equipment must also be implemented. No worker may work on or be exposed to equipment or machinery without it first being de-energized, the energy source being isolated and locked and tagged then verified so that the equipment/machinery cannot start up or have an inadvertent release of a hazardous energy.
2. All contract employees that are to perform servicing or maintenance in a SC B&CB facility must also comply with this program or will be denied access to these areas.
3. All equipment and machinery containing hazardous energies purchased after May 1, 1994, must have an energy-isolating device which will accept a lockout device.

V. SCOPE

1. OSHA standards for the control of hazardous energies establish minimum requirements for the lockout and tagout of energy sources that could cause injury to personnel. These standards cover:

- How to perform a shutdown
- How to isolate equipment
- How to apply and remove lockout and tag warning devices
- How to safely release stored energy to assure that a zero energy state exists
- Training, audits, and record keeping

2. OSHA LOTO EXCEPTIONS:

- A. Plug and cord-connected electric equipment (e.g., portable hand or shop woodworking tools), when unplugged and the plug is under the exclusive control (in direct line-of-sight and within arm's length) of the employee performing the servicing and/or maintenance, are exempted from the prescribed LOTO procedure. Note: Plug lockout devices are recommended to control plug and cord-connected electrical equipment undergoing service or maintenance.
- B. Installation of connections or parts using welding or cutting on equipment pipelines, vessels or tanks under pressure (hot tap operations) is allowed only when continuous service is essential, shutdown is impractical and documented procedures and special equipment are used that provide effective employee protection. Note: Supervision must make a prior determination and document that employees are authorized for each specific hot tap operation. Such authorization must include the work location, work to be accomplished and special work procedures and protective equipment to be used. "Blanket" authorization for hot tap operations, i.e., for an indefinite time or for more than one job, is not allowed.
- C. Normal production operations or servicing or maintenance during normal production operations are exempted from the prescribed LOTO procedure. Note: General Services does not perform any defined production operation.

VI. RESPONSIBILITIES

- 1. By this program, the General Services Division establishes mandatory procedures for the control of hazardous energies through the de-energization of equipment or machinery and energy isolation using a lockout/tagout work practice. Hazardous energy sources in each building, equipment and machine is required to have control procedures for shutdown, equipment isolation, lockout/tagout application, release of stored energy, and verification of isolation.
- 2. Employee position descriptions state minimum knowledge, skills and abilities for each job. OSHA standards and General Services Training Policy require initial and recurring training for each position involving equipment servicing or maintenance operations needing the control of hazardous energies.
 - A. Individual training plans for these jobs include LOTO or Electrical Safety training, or both.
 - B. Electrical Safety:
 - (1) Employees shall be trained in and familiar with the safety-related work practices required by 29 CFR 1910.331 through 1910.335 that pertain to their respective job assignments.
 - (2) Workers and their supervisors need to be trained in Electrical Safety if the workers are exposed to 50 volts or more to ground for a hazard to exist.
 - (3) Employees in General Services do not work with high voltage (over 600 volts) electrical power generation or transmission systems.
 - (4) For the purposes of safe work practices with electrical systems, a person must have the following training in order to be considered a **QUALIFIED PERSON**:
 - a. The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment.

- b. The skills and techniques necessary to determine the nominal voltage of exposed live parts.
 - c. The clearance (approach) distances specified in 1910.333(c) Table S-5 and the corresponding voltages to which the qualified person will be exposed.
 - d. Qualified persons whose work on energized equipment involves either direct contact or contact by means of tools or materials must also be capable of working safely on energized circuits and shall be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools.
- (5) The instruction and hands-on training received by authorized employees includes:
- a. Recognition of hazardous energies;
 - b. Types and magnitudes of hazardous energies found in the workplace;
 - c. A hands-on demonstration of the means and methods of isolating and/or controlling various hazardous energies should include but are not limited to the following:
 - 1. Electrical -
 - (a) Circuit Breaker – Examples:
 - 277/480/600 Volt - No Hole
 - Universal Multiple Breaker
 - Single Pole
 - (b) Fuse
 - (c) Wall Switch
 - (d) Plug
 - 2. Mechanical:
 - (a) Ball Valve
 - (b) Gate Valve
 - (c) Chain
 - 3. Safety Hasps (for situations involving more than one employee)
 - 4. Locks
 - 5. Tags
 - d. The means of verification of effective energy control, and the purpose of the procedures to be used.
 - e. Each employee must be able to demonstrate in a hands-on class, on-the-job training and during routine work practices the proper selection and application of the appropriate LOTO devices for the specific tasks that exist in their work environment.
- (6) Affected employees are to be instructed in the purpose and use of the energy control procedures.
- (7) All other employees who may be affected by the energy control procedures are to be instructed about the procedure and the prohibition relating to attempts to restart or reenergize such machines or equipment.
- (8) Certification of training: Transcripts of employee safety training will be maintained in a computer database maintained by the Safety staff.
- (9) Retraining of authorized and affected employees is required:
- a. Whenever there is a change in employee job assignments;

- b. Whenever a new hazard is introduced due to a change in machines, equipment or process;
 - c. Whenever there is a change in the energy control procedures; or
 - d. Whenever a periodic inspection by the employer reveals inadequacies in the company procedures or in the knowledge of the employees.
- C. The Job Safety Analysis (JSA) technique allows each team to look at their work process steps, identify hazards and implement controls. Each team is to conduct a JSA for each piece of equipment and machinery or work process where servicing or maintenance involves potentially hazardous energies. Each JSA is to identify and document the specific types of energy to be controlled, where isolation devices are located and how the hazardous energy is to be controlled for each piece of equipment and machinery.
 - (1) A survey of facilities, equipment and machinery is required to identify the location of all isolating devices.
 - (2) The supervisor is to inform subordinates of the physical and health hazards and control measures associated with the work.
 Example: Material Safety Data Sheets for chemicals in a pipeline requiring service or maintenance should be discussed and made available to each worker prior to the work. In addition to the types of LOTO to be used, the supervisor should cover personal protective equipment, spill prevention and cleanup, first aid and emergency notification procedures.
- D. The budgeting for and purchase of LOTO devices, locks, tags, etc. is each team's own responsibility.
- 3. Enforcing the program.
 - A. Team Leaders, Supervisors and/or Safety Support will verify program compliance by observing that workers are following proper LOTO procedures. These inspections:
 - (1) Must be conducted at least annually.
 - (2) Must be conducted by an authorized person.
 - (3) Are to validate proper procedures being used by the workforce.
 - (4) May be implemented through random audits and/or planned visual observations.
 - (5) Must be documented. Safety Support will maintain inspection records.
 - B. Deviations from or procedural inadequacies that are identified during periodic inspections of the energy control procedure will be investigated by Safety Support and reported to the employee's supervisor for appropriate corrective actions.

VII. **Lockout/Tagout (LOTO) Procedure**

NOTE: All equipment or parts will be considered as ENERGIZED until all LOTO steps are completed.

CAUTION: Placing a machine or piece of equipment in a safe work condition is in itself a potentially hazardous task.

1. **NOTIFY:** Before LOTO controls are applied, the Authorized Employee must tell all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out and/or tagged out.

Affected and other employees, as required, are to be informed not to attempt to operate the machine or equipment, or to remove the LOTO, and that they will be informed when the machine or equipment is returned to service.

2. **PREPARE FOR SHUTDOWN:** The Authorized Employee must know the type and strength of the energy, the hazards to be controlled, and the method(s) to control the energy/hazards. CAUTIONARY NOTE: A single machine or piece of equipment can have more than one power source. Each power source isolation device must be identified. (A Job Safety Analysis for each machine or equipment should be done to indicate in writing the hazardous energy sources, where the normal operational controls are located, and what type and where lockout/tagout devices are to be applied.)
3. **SHUTDOWN:** Turn off the machine or equipment using the normal established procedure.
4. **ISOLATE:** Locate and de-activate all energy isolating devices so that the machine or equipment is isolated from all energy sources. CAUTIONARY NOTE: A single machine or piece of equipment can have more than one power source. Each power source must be identified, shut down, and secured against inadvertent re-activation or release of energy.
5. **APPLY LOTO:** The Authorized Employee will apply LOTO devices to each energy source (Lockout devices hold the energy-isolating device in a safe, neutral or the “Off” position. Tagout devices are a clear warning prohibiting operators and others from removing the LOTO device(s) or attempting to restore power for equipment operation.)
NOTE: LOTO devices are only to be used for controlling energy; other use is prohibited.
 - A. **MULTIPLE EMPLOYEES:** When more than one employee is servicing/maintaining the same machine or equipment, each employee is to apply his/her own lock. A safety hasp LOTO device is to be used when more than one employee needs to apply their locks to simultaneously work on the same machine or equipment (see Appendix B).
 - B. **SHIFT CHANGE:** Some jobs require more than one work shift to complete. When conducting a shift change, the oncoming employee will apply his/her lock prior to the employee going off shift removing his/her lock. The oncoming employee will verify LOTO is properly implemented prior to beginning work.
6. **SAFE STORED ENERGY:** All potentially hazardous stored or residual energy shall be relieved, disconnected, restrained or rendered safe.
7. **VERIFY ISOLATION:** Prior to starting work on machines or equipment that have been locked out or tagged out, the Authorized Employee will verify that isolation and de-energization was accomplished.
 - A. Check that no persons are exposed.
 - B. Push the button or other operational controls or use test equipment to make certain the machine or equipment will not operate.
 - C. Return operating controls to Neutral or the “Off” position after verification.
 - D. Electrical: Use test equipment to determine that no electrical power is being stored or supplied to the machine or equipment.NOTE: Voltage testing while completing LOTO is considered as working on live (energized) parts.

8. TESTING OR REPOSITIONING EQUIPMENT (TEMPORARY

RE-ENERGIZATION): If the machine or equipment has to be temporarily re-energized in order for a part of the machine to be repositioned, or if the equipment has to be tested as part of the servicing or maintenance, use the following procedure:

- A. Clear the machine or equipment of all tools, materials and non-essential items.
- B. Clear Affected Employees from the vicinity.
- C. Remove any LOTO devices required to reposition or test the machine or equipment.
- D. Energize the Energy Isolation Devices and Turn the machine or equipment on using normal procedures.
- E. Proceed with repositioning and/or testing.
- F. When repositioning and testing are completed, de-energize the equipment or machine in accordance with the previously described LOTO procedure (return to Step 3).

9. RESTORING THE MACHINE OR EQUIPMENT TO SERVICE:

A. INSPECT:

- (1) Ensure nonessential items have been removed and that machine or equipment components are operationally intact.
- (2) Before LOTO devices are removed and energy is restored to the machine or equipment, Affected Employees must be told that LOTO controls are going to be removed. Ensure all employees have been safely positioned or removed from the area.

B. REMOVE LOTO DEVICES:

- (1) Verify the operational controls are in Neutral or Off.
- (2) The Authorized Employee who installed the LOTO device will remove and account for all LOTO devices that were installed. **CAUTIONARY NOTE:** If the Authorized Employee is for some reason not available, that employee's immediate supervisor can authorize removal of LOTO devices. When a lock is used as a lockout device, there will be two keys; the Authorized Employee will keep one key and the Authorized Employee's immediate supervisor will keep the other key. The supervisor must ensure the absent employee is informed that the lock was removed before he/she resumes work at that facility.

C. RE-ENERGIZE THE MACHINE OR EQUIPMENT.

- D. **NOTIFY:** Tell the affected employees that the servicing or maintenance is completed and the machine or equipment is ready for use.

VIII. Guarding Procedure for Working ON or NEAR Exposed ENERGIZED Electrical Parts:

With Careful Planning, Work Can Almost Always Be Done With Equipment **DE-ENERGIZED**. Financial or Customer Comfort Considerations are NOT Adequate Reasons to Work On or Near Energized Circuits.

NOTE: Only Qualified Persons may work on electric circuit parts or equipment that have not been de-energized.

- 1. If an employee can be exposed to any hazardous live parts that must remain energized, additional measures other than LOTO must be used. Protective measures

such as guarding, isolating and/or insulating as well as the following work practices are to be used to protect employees against contact with energized circuit parts directly with any part of their body or indirectly through some other conductive object. Work on live equipment is only allowed if the employer can show that de-energizing is not feasible, such as:

- A. De-energizing introduces additional hazards, i.e., an interruption of an emergency alarm system.
 - B. De-energizing increases the hazards involved in doing the job, i.e. shutting down the ventilating system in purging a hazardous atmosphere.
 - C. De-energizing, by the nature of the equipment or installation, requires the shutdown of the whole operation.
2. Workers are prohibited from blindly reaching into areas with energized live parts.
 3. Qualified employees should avoid contact with live equipment of 300 volts or less and avoid live equipment of more than 300 volts by at least 1 foot minimum (Table S-5, 29 CFR 1910.333(c), stipulates minimum approach distances for equipment voltage).
 - A. Conductive materials and equipment that are in contact with any part of an employee's body shall be handled in a manner that will prevent them from contacting exposed energized conductors or circuit parts. If an employee must handle long dimensional conductive objects (such as ducts and pipes) in areas with exposed live parts, the employer shall institute work practices (such as the use of insulation, guarding, and material handling techniques) which will minimize the hazard.
 - B. Conductive articles of jewelry and clothing (such as watch bands, bracelets, rings, key chains, necklaces, cloth with conductive thread, or metal headgear) may not be worn if they might contact exposed energized parts.
 4. **ILLUMINATION:** Employees may not enter spaces containing exposed energized parts, unless illumination is provided that enables the employees to perform the work safely. Where lack of illumination or an obstruction precludes observation of the work to be performed, employees may not perform tasks near exposed energized parts. Employees may not reach blindly into areas that may contain energized parts.
 5. **AERIAL LIFTS:** When an unqualified person is working on the ground in the vicinity of overhead lines, or if any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines shall be operated so that a clearance of 10 ft. is maintained. If the voltage is higher than 50kV, the clearance shall be increased 4 in. for every 10kV over that voltage.
 6. **CONFINED OR ENCLOSED WORK SPACES:** When an employee works in a confined or enclosed space that contains exposed energized parts, General Services shall provide, and the employee shall use protective shields, protective barriers, or insulating materials as necessary to avoid inadvertent contact with these parts. Doors, hinged panels, and the like shall be secured to prevent their swinging into an employee and causing the employee to contact exposed energized parts.
 7. **PORTABLE LADDERS:** Portable ladders shall have nonconductive side-rails if used where the employee or the ladder could contact exposed energized parts.
 8. **GENERAL PROTECTIVE EQUIPMENT AND TOOLS:** When working near exposed energized conductors or circuit parts, each employee shall use insulated tools

or handling equipment if the tools or handling equipment might make contact with such conductors or parts. If the insulating capability of insulated tools or handling equipment is subject to damage, the insulating material shall be protected. Fuse handling equipment, insulated for the circuit voltage, shall be used to remove or install fuses when the fuse terminals are energized. Protective shields, protective barriers, or insulating materials shall be used to protect each employee from shock, burns, or other electrically related injuries while that employee is working near exposed energized parts that might be accidentally contacted or where dangerous electric heating or arcing might occur. When normally enclosed live parts are exposed for maintenance or repair, they shall be guarded to protect unqualified persons from contact with the live parts.

- IX. **PERSONAL PROTECTION**: The employer must provide protective equipment to include personal protective equipment (PPE) to their employees who must work where there is a risk from potentially hazardous energies. The PPE must comply with ANSI standards appropriate for the hazard. General Services Safety staff will assist Team Leaders and/or their representatives conduct Job Safety Analysis of work processes, as required, to determine appropriate PPE. The required PPE for specific work processes will be documented in a PPE Assessment (see PPE, Safety Footwear and Safety Eyewear policies). Example: Employees shall wear nonconductive and fire-resistant PPE whenever there is a danger of injury from arc flash, electric shock or burns due to contact with exposed energized parts.

1. Gloves: Gloves and sleeves come in various materials to provide hand and arm protection according to the hazard, i.e., chemical, thermal, and electrical.
2. Safety footwear provides varying types of foot protection, i.e., chemical, electrical.
3. Head Protection: Industrial caps or hats provide protection for the head or portions thereof against impact from small falling objects striking the top of the shell and against light bumps, flying particles, or electric shock or any combination:
 - A. Class A: Provides impact resistance and low (2,200)-voltage protection.
 - B. Class B: Provides impact resistance and high (20,000)-voltage protection.
 - C. Class C: Not For Electrical Use. Provides impact resistance but no electrical protection.
4. Safety Eyewear: Employees shall wear protective equipment for the eyes or face wherever there is danger of injury to the eyes or face from electric arcs or flashes or from flying objects resulting from electrical explosion; grinding; welding; or chemical splashes are occurring or likely to occur.
5. Fire-resistant clothing: Employees shall wear fire-resistant long-sleeve shirts and pants wherever there is danger of injury from electrical shock or arc flashes or blasts, i.e., whenever working within the flash boundary for energized circuits of 50 volts or more. Though most work done by FM employees is at 240 volts or less, there is occasion where there is work on higher risk tasks up to 600 volts that equates to a Hazard/Risk Category 2. This level of risk requires flame-resistant clothing to provide a minimum protection of a 4 Arc Rating.
6. Insulated tools: When working on 50 volts ac or more to ground, insulated tools must be used.
7. Insulating blankets can protect workers from low-voltage electrical hazards. When Normally Enclosed Live Parts Are Exposed for Maintenance or Repair, They Shall Be Guarded to Protect Unqualified Persons From Contact With the Live Parts.

- X. **EMPLOYEE WARNINGS:** Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about hazards that may endanger them. Barricades shall be used in conjunction with safety signs where it is necessary to prevent or limit employee access to work areas exposing employees to work with hazardous energies. If signs and barricades do not provide sufficient warning and protection from hazards, an attendant shall be stationed to warn and protect employees.

APPENDIX A

TERMINOLOGY:

AFFECTED EMPLOYEE: Someone whose job requires being in close vicinity to, operating or using a machine or equipment which is subject to servicing or maintenance under LOTO procedures. NOTE: Affected employees only need training to the point that they are aware of the LOTO program and how to recognize when LOTO is in effect.

APPROACH DISTANCES: Applies to work performed on exposed live parts (involving either direct contact or contact by means of tools or materials) or near enough to them for employees to be exposed to any hazard they present. Only qualified persons may work on electric circuit parts or equipment that have not been de-energized under the prescribed procedures.

29 CFR 1910.333 Table S-5 APPROACH DISTANCES
for Qualified Employees - Alternating Current

| Voltage range (phase to phase) | Minimum approach distance |
|--------------------------------|---------------------------|
| 300V and less | Avoid contact |
| Over 300V, not over 750V | 1 ft. 0 in. (30.5 cm) |
| Over 750V, not over 2kV | 1 ft. 6 in. (46 cm) |
| Over 2kV, not over 15kV | 2 ft. 0 in. (61 cm) |
| Over 15kV, not over 37kV | 3 ft. 0 in. (91 cm) |
| Over 37kV, not over 87.5kV | 3 ft. 6 in. (107 cm) |
| Over 87.5kV, not over 121kV | 4 ft. 0 in. (122 cm) |
| Over 121kV, not over 140 kV | 4 ft. 6 in. (137 cm) |

AUTHORIZED EMPLOYEE: A person who has been trained (see Qualified Person) and designated to perform servicing or maintenance on specified machinery or equipment to include applying lockout and/or tagout for the control of potentially hazardous energies.

CIRCUIT PROTECTION: Devices designed to automatically limit or shutoff electrical flow in event of a ground-fault, overload or short-circuit. Note: Current values exceeding the limits for which a wire was designed causes overheating resulting in the wire softening, damaging the insulation (melted, brittle, cracked) and exposing bare wires creating electrocution and/or fire hazards. Damage from overheating results from using too small of a cable or wire for the required load. To prevent an over-current or overloading from occurring, the proper size wire should be used for the load and a circuit protection device must be installed in the line with the circuit.

A. **FUSE:** An over-current protective device with a circuit opening fusible part that is heated and severed by the passage of over-current through it.

1. Designed to melt and burn in two at a set current value, i.e. commonly 15/20/30 amps for households and 100/200 amps and greater for industrial

2. Plug fuse screws into holder
 3. Cartridge fuse held by contacts
- B. CIRCUIT BREAKER: an electromechanical switch inside is tripped open by heat generated due to the overloaded circuit; can be reset and reused over and over but a tripped circuit breaker is indicative of a defective circuit.
1. (600 volts nominal or less). A device designed to open and close a circuit by non-automatic means and to open the circuit automatically on a predetermined over-current without injury to itself when properly applied within its rating.
 2. (Over 600 volts, nominal). A switching device capable of making, carrying, and breaking currents under normal circuit conditions, and also making, carrying for a specified time, and breaking currents under specified abnormal circuit conditions, such as those of short circuit.
- C. GROUND-FAULT CIRCUIT INTERRUPTER (GFCI): A device whose function is to interrupt the electric circuit to the load when a fault current to ground exceeds some predetermined value that is less than that required to operate the over-current protective device of the supply circuit.
1. Compares electric current output and return then can shut off power within as little as 1/40th of a second when the two values differ by a set amount.
 2. Used in high-risk areas such as wet locations and construction sites. Only protects line to ground faults; does not provide complete protection.

DIAGNOSTICS: Troubleshooting of live (energized) equipment using test instruments. Only qualified persons may perform testing work on live electric circuits or equipment. Test instruments and equipment and their accessories shall be rated for the circuits and equipment to which they will be connected and shall be designed for the environment in which they will be used.

DISCONNECTING MEANS: A device, or group of devices, or other means by which the conductors of a circuit can be disconnected from their source of energy.

ENERGIZED: Connected to an energy source or containing residual or stored energy.

ENERGY ISOLATING DEVICE: A mechanical device that physically prevents the transmission or release of energy. Examples: Manually operated circuit breaker, disconnect switch, line valve.

ENERGY (POWER) SOURCE: Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal or other energy.

GUARDED: Covered, shielded, fenced, enclosed, or otherwise protected by means of height or suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach to a point of danger or contact by persons or objects.

GROUND: A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth (offering a path of sufficiently low resistance and current carrying capacity to prevent dangerous

voltage buildups). NOTE: Grounding is not a guarantee against shock, injury or death but will substantially reduce the possibility of such incidents.

A. Service or System Ground - one wire (the service entrance earth ground to which the system ground and neutral are connected) is the neutral or ground wire.

1. The white or gray wire is grounded at the generator or transformer and again at the service entrance of the building
2. Used to protect machines, tools and insulation against damage

B. Equipment Ground

1. An additional ground from the tool or machine to the ground
2. Used to protect the worker in the event a malfunction accidentally energizes the tool's metal frame

GUARDING (ELECTRICAL): Locations containing exposed live parts must be marked with conspicuous warning signs forbidding unqualified persons from entering

A. Live parts of electrical equipment operating at 50 volts or more must be guarded against accidental contact by:

1. Enclosure (room or vault) accessible only to qualified persons
2. Permanent partitions or screens to exclude unqualified persons
3. Located 8 feet or more off of the floor
4. In electrical platform, balcony or gallery

B. Indoor electrical installations with live parts of electrical equipment operating at over 600 volts and open to unqualified persons must be:

1. Made with metal-enclosed equipment
2. Enclosed in a vault controlled by a lock

HOT TAP: A repair, maintenance or service procedure involving welding or cutting on a piece of equipment (pipelines, vessels or tanks) under pressure in order to install connections or parts.

HOT WORK: Electric or gas welding or cutting operations are considered “hot” work.

INSULATION: any material with a high resistance to electrical current (amperes near 0), i.e. glass, mica, rubber, plastic

A. Used to prevent shock, fires, short circuits and accidental contact with the current

B. Circuit conductors generally are required to have insulation (29 CFR 1910 Subpart S, Design Safety Standards for Electrical Systems)

1. Should be suitable for the voltage and conditions such as temperature, moisture, oil, gasoline and corrosive fumes
2. Conductors and cables should be marked by the manufacturer to show maximum voltage, American Wire Gage size, type letter of the insulation, and the manufacturer's name or trademark
3. Insulation is color coded:
 - a. Equipment/Frame Grounding conductors - continuous green or green with yellow stripes or non-insulated (bare) wire
 - b. Grounded conductors (that complete a circuit) - white or natural gray
 - c. Ungrounded conductors ("hot" wires) - any other color; most often red or black

LIVE EQUIPMENT: Equipment or machinery being powered by one or more energy sources. Controls are typically electrical powered while other energy sources can power other parts of the machine or equipment. Work on live equipment is only allowed if the employer can show that de-energizing is not feasible.

1. De-energizing introduces additional hazards, i.e., an interruption of emergency alarm system.
2. De-energizing increases the hazards involved in doing the job, i.e. shutting down the ventilating system in purging a hazardous atmosphere.
3. De-energizing, by the nature of the equipment or installation, requires the shutdown of the whole operation. Where electrical equipment and circuits can't be de-energized before they are to be worked on or near:
 - a. Only qualified persons are allowed.
 - b. Sufficient illumination is required.
 - c. Other safety-related work practices must be employed to protect the worker from contact.
4. Workers are prohibited from blindly reaching into areas with energized live parts.
5. If there is less than 50 volts and no increased exposure to electrical burns or explosion due to arcing.

LOCKOUT/TAGOUT (LOTO): A work practice (see procedure) to de-energize equipment, apply a lockout device on each energy isolating device (its disconnection), and tagout of the equipment to ensure the equipment being controlled cannot be operated before servicing, maintaining or making repairs. Where the machine or equipment can be de-energized and LOTO used in order to safely perform the servicing or maintenance, de-energization and LOTO will be performed.

LOCKOUT DEVICE: An apparatus that holds an energy-isolating device in a safe position. These devices shall be substantial enough to prevent removal without the use of excessive force or unusual techniques. Examples: Locks (keyed locks are preferred to combination locks because the individual retains sole control), bolted slip blinds, blank flanges, pins, chains, wedges, valve clamps. Each device shall indicate the identity of the employee applying it. The employee should be identified by name, employee number or assigned code. The device is not to be removed without the permission of the Authorized Employee, and it is not to be bypassed, ignored or defeated. Only the supervisor can authorize the removal of a LOTO device in an emergency where the Authorized Employee is not available and the Authorized Employee is informed before his/her return to work of the removal.

MAY - A discretionary right, privilege, or power is conferred by the word "may."

MAY NOT - If a right, privilege, or power is abridged or if an obligation to abstain from acting is imposed, the word "may" is used with a restrictive "not" or "only."

OVERCURRENT: Any current in excess of the rated current of equipment or the capacity (in amperes) of a conductor. It may result from overload, short circuit, or ground fault. A current in excess of rating may be accommodated by certain equipment and conductors for a given set of conditions. Hence the rules for over-current protection are specific for particular situations.

OVERLOAD: Operation of equipment in excess of normal full-load rating or of a conductor in excess of rated capacity (in amperes) which, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload.

PERMIT: A written authorization from a supervisor designating what job is to be done, which employees are involved, the location, hazards that are involved, what procedures and/or equipment are required to protect the employees, any other tools and/or procedures relevant to accomplishing the task, and rescue recovery operations. Permits will be limited to specified start and finish dates and times. Example: Work in permit-required confined spaces.

QUALIFIED PERSON: A designated and trained employee familiar with the construction and operation of the equipment and the hazards involved. Example: A qualified electrician is an employee who has had training in avoiding the electrical hazards of working on or near exposed energized parts. (For General Services this includes premises wiring, wiring for connection to supply, and optical fiber cable. Power generation, transmission, and distribution installations; communications installations; and installations in vehicles, which are covered by other standards, are not performed by General Services employees.)

- A. "Qualified" depends on the workplace, i.e., it is likely for an employee to be considered "qualified" with regard to certain equipment in the workplace, but "unqualified" as to other equipment. Example: An employee may be qualified to work on a motor in a mechanical room but not qualified to work on the same type motor in a permit required confined space.
- B. An unqualified employee who is undergoing on-the-job training and who has demonstrated an ability to perform duties safely at his/her level of training, and who is under the direct supervision of a qualified person, is considered to be a qualified person up to the level of his/her training.

SAFETY HASP: When more than one employee is servicing/maintaining a machine or equipment, each employee is to apply his/her own lock. A safety hasp is a LOTO device that allows more than one lock to be applied simultaneously. A safety hasp is also typically used when a shift change and change of personnel is expected so positive control (lockout) can be maintained at all times (the on-coming employee applies his/her lock prior to the off-going employee removes his/her lock).

SERVICING / MAINTENANCE: Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, maintaining, repairing, lubricating, cleaning, or unjamming machines or equipment; and/or making adjustments or tool changes.

SHALL or WILL: Mandatory

SHALL NOT - is a prohibited activity.

SHOCK (ELECTRICAL): the physiological effect, severe injury or death that occur when an electric current passes through the body.

- A. A person becomes a part of the electrical circuit when he/she comes in contact with:
 - 1. Both wires of electrical circuit

2. One wire of the electrical circuit and the ground
 3. Metallic part that is "hot" (in contact with an energized wire) and in contact with the ground, i.e. due to a break in the insulation
- B. Severity of shock is affected by:
1. Amount of current flow (amperes)
 2. The path through the body
 3. Length of time the body is in the circuit
 4. Current frequency
 5. Phase of heart cycle
 6. Person's general health
- C. Effects of Electric Current in the Human Body:
1. *The body is a conductor.* A voltage difference causes a current flow. Current will flow through the body when a voltage difference is present between two points on the body.
EXAMPLE: The earth has zero (0) voltage so a person (conductor) placed between a power line and the earth would conduct current.
 2. The following two charts show the resistance in ohms that were determined in actual tests from passing 110 volts through various body paths (Volts / Ohms = Current).

TYPICAL BODY RESISTENCE

| BODY PATH | RESISTANCE | CURRENT (milli-amps) |
|--------------|------------|----------------------|
| Ear to Ear | 100 | 1,100 mA (110/100) |
| Head to Foot | 500 | 220 mA |
| Dry Skin | 350,000 | 0.3 mA |
| Wet Skin | 1,000 | 110 mA |

Note: AS LITTLE AS 27 VOLTS CAN BE FATAL.

| CURRENT | REACTION |
|----------------|---|
| 1 mA | Faint Tingle |
| 5 mA | Slight Shock; Strong Involuntary Reactions but Can Let Go |
| 9 - 30 mA | Painful Shock; Lost Muscular Control |
| 50 - 150 mA | Respiratory Arrest; POSSIBLE DEATH ! |
| 1000 - 4300 mA | Heart Fibrillation; DEATH LIKELY |
| 10,000 mA | Cardiac Arrest, Severe Burns; DEATH PROBABLE |

3. POSSIBLE RESULTS OF ELECTROCUTION:

- a. **CARDIOPULMONARY** problems. The most dangerous path is through the chest and heart (from one arm to the opposite leg) as that can stop cardiopulmonary (heart and/or lung) functions.
- b. **BURNS:** All three types of burn can occur simultaneously resulting in internal hemorrhages, tissue/nerve/muscle destruction, and/or broken bones.
 - (1) Electrical burn - current flows through tissues or bones resulting in one of the most serious of injuries.

- (2) Arc or Flash burn - person near to arc or explosion with high temperatures.
- (3) Thermal contact burn - skin contacts hot surface.
- c. *SECONDARY INJURIES* from falls, cuts, explosions, fires. TAGOUT: The placement of a tagout device on an energy-isolating device IAW standard procedure.

SHOULD / SHOULD NOT – a recommended (not mandatory) practice.

TAGOUT DEVICE: A prominent warning, such as a tag and a means of attachment, securely fastened to an energy-isolating device to indicate the energy isolating device and equipment being controlled may not be operated until the tagout device is removed. Examples of Tagout warning: DO NOT START, DO NOT OPERATE, DO NOT OPEN, DO NOT CLOSE, or DO NOT ENERGIZE. Tagout devices and their means of attachment shall be substantial enough to prevent inadvertent or accidental removal. Each tagout device shall indicate the identity of the employee applying it. The employee should be identified by name, employee number or assigned code. The tagout device is not to be removed without authorization of the responsible person, and it is never to be bypassed, ignored or defeated. Where the machine or equipment can be de-energized but lockout is not feasible to perform the servicing or maintenance, de-energization and tagout will be performed. CAUTIONARY NOTE: Tags may evoke a false sense of security. Tagout devices do not provide the physical restraint of a lockout device. Where the machine or equipment can be de-energized and lockout/tagout used to perform the servicing or maintenance, de-energization and lockout/tagout will be performed.

APPENDIX B

LOCKOUT / TAGOUT DEVICES

MINIMUM REQUIREMENTS

Locks shall be:

1. Instantly identifiable as equipment to be used in the General Services Lockout/Tagout Program, i.e., color-coded by team, and shall not be used for any other purpose
2. Individually keyed and identified by a red band. There are to be only two keys per lock with one key in the employee's possession and the other key under the supervisor's control.
3. Substantial enough to prevent removal without the use of excessive force or unusual techniques (such as the use of bolt cutters or other metal cutting tools).
4. Capable of withstanding the environment to which they are exposed.
5. Used with a hasp when more than one person is expected to simultaneously work on the same equipment/machine or there is to be a shift change.

Examples:



Lock



Hasp

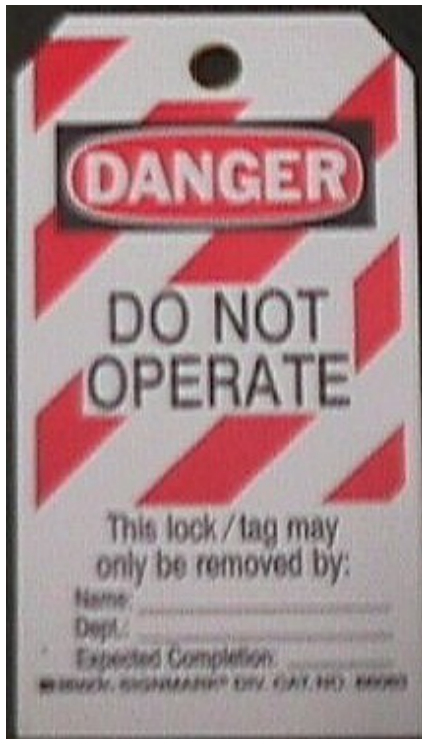


Hasp with Multiple Locks

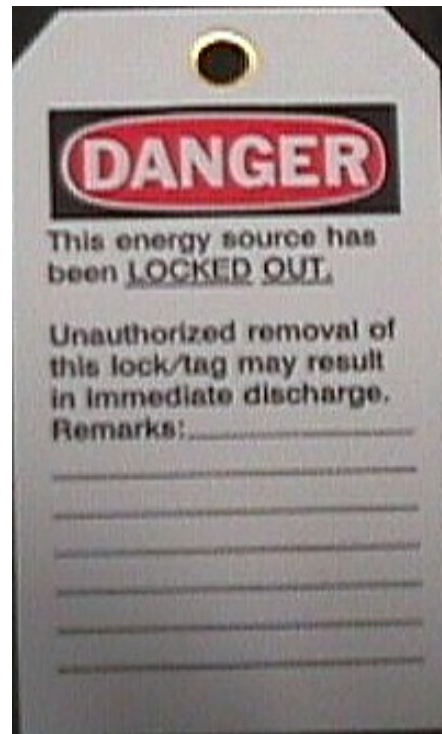
TAGS shall be:

1. Instantly identifiable as warnings for lockout/tagout purposes. A message shall warn of a hazardous condition if the machine or equipment is energized with words such as, "Do Not Operate," "This energy source has been locked out," and "This lock/tag may only be removed by (space for employee's name)." The authorized worker that attaches a tagout should include his/her name, Team name, and expected completion date on the tag.
2. Used whenever a lock is applied to control a hazardous energy.
3. Constructed so as to resist the effects of exposure to weather conditions, wet and damp locations or corrosive environments.
4. Attached to the lock directly or with a tie substantial enough to prevent inadvertent or accidental removal.
5. Replaced when the tag becomes damaged or not readable.

Example:












Tag - Front



Tag - Back

EXAMPLES OF LOTO

| ISOLATION DEVICE | LOCKOUT DEVICE | LOTO APPLIED |
|---|--|---|
|  <p style="text-align: center;">Ball Valve</p> |  <p style="text-align: center;">Lockout for Ball Valve</p> |  <p style="text-align: center;">Ball Valve: LOTO applied</p> |
|  <p style="text-align: center;">Gate Valve</p> |  <p style="text-align: center;">Lockout for Gate Valve</p> |  <p style="text-align: center;">Gate Valve: LOTO applied</p> |
|  <p style="text-align: center;">Fuse Block</p> |  <p style="text-align: center;">Lockout for Fuse Block</p> |  <p style="text-align: center;">Fuse Block: LOTO applied</p> |

Other LOTO devices are available for various situations. Contact Safety Support or a local safety equipment vendor to determine the appropriate device for specific equipment. Note: Universal LOTO devices do not work as well as LOTO devices designed to fit specific equipment.